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Chapter 1 : Shhh, the Ants Are Talking | Science | AAAS

Insects use almost all senses to communicate. Along this section, we'll analyze one by one all communication systems that insects developed through the "five sense", just like some of the flashiest examples.

Chemical Communication Throughout the animal kingdom, from the simplest creature to the most complex, some form of communication takes place. Although most of us think of it in terms of sound, actually there are four methods of communicationâ€”auditory sound , visual sight , tactile touch , and chemical smell and taste. Chirps, croaks, howls, barks, gobbles, and other such vocalizations are obvious examples of auditory communication. These sounds make it possible for animals to remain hidden while talking; however, the sounds also are heard by others and may bring a predator to lunch. Auditory communication is limited by the distance the sound can be heard. Animals send visual messages to each other by twitching the tail, winking an eye, lowering the head, pawing the ground, bristling body hair, flashing wing color, arching the back, or making other such movements. Since animals sending visual messages must be seen while communicating, their body language also may attract the attention of a nearby predator. Communicating distance for visual messages is limited by the eyesight of the receiver. Tactile communication requires actual contact between animals and includes such gestures as a lick, nip, slap, shove, rub, or nuzzle. Coyotes, like the family dog, use urine to mark the boundaries of their territories. These chemical messages tell other canines whether the animal that left the scent is a male or female and whether it poses a threat. The most widely used method of communication, and the one we intend to study more closely, is the invisible language of odors. These silent messages consist of chemical substances called pheromones FER-ah-moanz. It should be pointed out that not all odors are pheromones. Humans recognize and respond to a variety of odors, such as food, but we do not consciously communicate with each other through pheromones. In fact, we do everything possible to wash away or disguise with artificial scents any body odors we might have. Researchers restrict the use of the word pheromone to describe chemical messages that pass between animals of the same species. Although it may seem a bit confusing, an odor can be a pheromone to one creature and merely an odor to another. For example, when a rabbit leaves a scent to convey a message to another rabbit, the scent is a pheromone. To the coyote, the scent is an odor, not a pheromone. Pheromones consist of many combinations of chemicals that are produced in gland found on the face, head, chest, arms, legs, back, rump, between the toes, or in several such locations. Some also are situated so they can add chemicals to body wastes. Each odor has a specific message and may travel as liquid, vapor, or gas in water or air or on the ground. Both taste and smell are used to interpret these chemical messages. Pheromones carry information about such things as identity, territory, sex, food, assembly, and danger. Identity Almost every species of animal has its own body scent, but there are additional odors that serve as chemical passports to identify individual animals, family groups, or members of a colony. For example, all ants have distinctive body odors that indicate the nest to which they belong and their job within the nest. When two ants meet, they use their antennaeâ€”the organs that carry their sense of smellâ€”to establish their identities. If an ant enters the colony of a different kind of ant, its body odor identifies it as an enemy and brings on an attack. In some laboratory tests, ants washed clean of their colony odor and dabbed with the scent of an enemy ant were attacked by their own nest mates. When another ant, painted with the scent of a dead ant, was returned to its nest, its nest mates carried it out. When the dead scent wore off, the ant was allowed to remain in the nest. Territory A personal scent often is used to establish territorial boundaries. When marking its territory, the beaver makes patties of mud, wood chips, small sticks, and pebbles and then douses them with a chemical substance called castoreum. This odorous secretion, manufactured in glands located under the tail, contains at least forty-five chemical ingredients. It is possible that different combinations of these chemicals mean different things. Other beavers may cover this mud pie with their own scented patties, causing the smelly mound of mud to grow several feet high. Phermones gather animals together for various reasons. This large group of ladybugs probably has responded to such a chemical message. Rabbits secrete a colorless fluid from chin glands to mark the ground and plants in their territories. This marking process is known as chinning. The male cottontail may deposit his scent on an area two acres in size, while the male snowshoe rabbit claims as many as eighteen acres. Antelope have prominent facial glands for marking their territories. The scent is deposited at eye level on leaves and other vegetation so the odor cannot be missed by other antelope. Urine, with its added chemical scents, is used quite frequently for indicating territorial boundaries. Bears plaster mudâ€"often made by first wetting on the groundâ€"on trees and then rub against it. Hairs come off and stick in the mud adding more bear scent to the tree. Bison also urinate on the ground, roll in the resulting mud, and then rub against trees. Coyotes, wolves, and the family dog always use urine to identify their territories. You probably have watched a male dog sniff a tree, trash can, or fence post to read the scent message left by others. If he scratches the ground vigorously with his back legs or growls, he probably has identified the scent of a male dog that could be a possible challenger. If he whines and sniffs again, the scent probably was left by a female. If he displays no reaction, the scent probably was left by a smaller male or a friendly one that he knows poses no threat. Once he has read the messages and reacted to them, he usually wets on the object to leave his own scent. Although the first dog that wet on the object claimed the territory, the following dog may claim it too. By reinforcing the scent with frequent visits, a dog establishes his territorial boundaries, but one day he may be called upon to defend them. When two greyhounds, housebroken for ten years, suddenly began wetting on the furniture, rugs, and corners of the rooms, their master was astonished. The well-behaved dogs were completely confused by the invisible, scentless, but audible dog in their midst. Unable to find or confront the intruder, they were attempting to communicate with it by marking their territory and extending a challenge. Male squirrels are among those animals that sprinkle their mates with urine to mark them and warn other males to keep their distance. Sex Of all the different messages that are sent by pheromones, the most basic ones, except those for alarm, are related to sex Insects probably have the most effective long-range sex attractants. In one experiment, male silkworm moths were marked and released from a moving train at various distances from a caged female. Her chemical sex messages brought some of the males to her from a distance of seven miles. Although the amount of scent she is capable of producing is extremely small, it is estimated that if it were released all at once it would attract as many as a trillion males. Once she has mated, she stops producing pheromones that attract males. The strength of these insect sex pheromones has been the subject of many studies. In one five-day field test, a caged female pine sawfly attracted more than 11, males. Other researchers found the sex odor of the female cockroach strong enough to cause the male to respond when fanned with a piece of paper the female had merely walked across. It also has been observed that the pheromone the queen honeybee releases during her mating flight is strong enough to attract males from hundreds of yards away. When the young male alligator reaches maturity, it will be able to eject a powerful scent from glands located under its jaws to attract a mat during the spring breeding season. Bull alligators eject a jet of powerful scent from glands under their jaws to attract their mates. During the spring breeding season, this odorous vapor hangs over an alligator swamp like a fog. Barnacles discharge pheromones into the salt water to attract their free-swimming larvae. This chemical attractant leads the larvae to the established barnacle colony to enlarge it and provide more mates. In addition to its uses for territorial marking, urine also is used by many animals to transmit sex attractants. Female crabs secrete a chemical in their urine to attract the males. We can be sure that scent, not sight, is involved because male crabs, when placed in water that has previously held a ready-to-mate female, become excited by her lingering scent in the water. They assume mating positions even though no female crab is present. Many female fish also release chemicals into the water with their urine before they are ready to lay eggs. By the time the male fish catch the scent and follow it back to the female, they are ready to mate. In some fish species, the males release a scent that lures the females for courtship or triggers other males to seek mates. Researchers have determined that a female dog may have as many as fifty-two different chemical variations in her urine during a single year. By smelling and tasting her urine, male dogs are able to calculate her readiness to mate to the day, and her scent usually attracts more than one willing male. When the female weasel is ready to mate, she leaves a scent trail on the ground. If a male weasel discovers this trail, he follows, depositing his own scent in hopes that other males will be discouraged from following her too. With the aid of scents, ants are able to recognize nest mates and enemies, mark trails to food sources, give alarm signals, and relay many other messages required for the efficient management of the nest. Some animals, such as rabbits, squirrels, foxes, and porcupines, sprinkle their mates with urine to mark them and warn other males to keep their distance. The scout that discovers the food lays down the first trail. Other ants then follow it to the food and reinforce the scent on their way back to the nest. As the food supply grows smaller, less scent is left and fewer ants return to the food. When the food is gone, the last ant leaves no scent trail on the way back to the nest. Several experiments can be made with these ant trails. If you brush away a portion of one, the ants will scramble about in confusion until they locate it again. If you place a piece of paper between the nest and a food source, the ants will walk across it, depositing a chemical trail on the paper. By pivoting the paper, you will lead them down their trail and away from the food, but only for a short while. If there is no food at the end of the trail, the trail will be abandoned and the scouts will begin another search for food. You might also try shifting the food to see how long it takes the ants to relocate it. Houseflies do not make food trails, but they do leave a scent on food that will attract any other flies that are in smelling distance. Assembly Pheromones gather animals together for many different reasons.

Chapter 2 : What is new with Serial in Windows 10 â€“ Microsoft Windows USB Core Team Blog

For some insects, sound waves or vibrations are the real social media â€” high-speed rumbles sent through the air and along leaf stems to help the bugs claim territory, send warnings and find mates.

Functions[edit] Communication requires a sender, a message, and a recipient, although neither the sender or receiver need be present or aware of the others intent to communicate at the time of communication. Intra-specific communication[edit] Vibrations can provide cues to conspecifics about specific behaviours being performed, predator warning and avoidance, herd or group maintenance, and courtship. The Middle East blind mole-rat Spalax ehrenbergi was the first mammal for which vibrational communication was documented. These fossorial rodents bang their head against the walls of their tunnels, which was initially interpreted as part of their tunnel building behaviour, however, it was eventually realised they generate temporally patterned vibrational signals for long-distance communication with neighbouring mole-rats. Footdrumming is used widely as a predator warning or defensive action. It is used primarily by fossorial or semi-fossorial rodents, but has also been recorded for spotted skunks Spilogale putorius , deer e. European rabbits Oryctolagus cuniculus and elephant shrews Macroscelididae. The Asian elephant Elephas maximus uses seismic communication in herd or group maintenance [6] and many social insects use seismic vibrations to coordinate the behaviour of group members, for example in cooperative foraging. Females perceive these signals and respond to them to initiate a duet. Eavesdropping[edit] Some animals use eavesdropping to either catch their prey or to avoid being caught by predators. Some snakes are able to perceive and react to substrate-borne vibrations. The vibrations are transmitted through the lower jaw, which is often rested on the ground and is connected with the inner ear. They also detect vibrations directly with receptors on their body surface. Studies on horned desert vipers Cerastes cerastes showed they strongly rely on vibrational cues for capturing prey. Localisation of the prey is probably aided by the two halves of the lower jaw being independent. Wood turtles Clemmys insculpta , [13] European herring gulls Larus argentatus , [14] and humans [15] have learnt to vibrate the ground causing earthworms to rise to the surface where they can be easily caught. It is believed that deliberately produced surface vibrations mimic the seismic cues of moles moving through the ground to prey on the worms; the worms respond to these naturally produced vibrations by emerging from their burrows and fleeing across the surface. Assassin bugs Stenolemus bituberus hunt web-building spiders by invading the web and plucking the silk to generate vibrations that mimic prey of the spider. This lures the resident spider into striking range of the bug. The creeping grasshopper can escape predation by this spider if it produces vibrations similar enough to those of wind. Mole rats use reflected, self-generated seismic waves to detect and bypass underground obstacles - a form of "seismic echolocation". Production of vibrational cues[edit] Vibrational cues can be produced in three ways, through percussion drumming on the substrate, vibrations of the body or appendages transmitted to the substrate, or, acoustical waves that couple with the substrate. Direct percussion of the substrate can yield a much stronger signal than an airborne vocalization that couples with the substrate, however, the strength of the percussive cue is related directly to the mass of the animal producing the vibration. Large size is often associated with greater source amplitudes, leading to a greater propagation range. A wide range of vertebrates perform drumming with some part of their body either on the surface or within burrows. Individuals bang heads, rap trunks or tails, stamp or drum with front feet, hind feet or teeth, thump a gular pouch , and basically employ available appendages to create vibrations on the substrates where they live. This process involves rocking of the entire body with the subsequent vibrations being transferred through the legs to the substrate on which the insect is walking or standing. These are referred to generically as the stridulatory organs. Vibrations are transmitted to the substrate through the legs or body. Tymbal vibrations Insects possess tymbals which are regions of the exoskeleton modified to form a complex membrane with thin, membranous portions and thickened "ribs". These membranes vibrate rapidly, producing audible sound and vibrations that are transmitted to the substrate. Acoustically coupled Elephants produce low-frequency vocalizations at high amplitudes such that they couple with the ground and travel along the surface of the earth. It has been suggested that other large mammals such as the lion and rhinoceros may produce acoustically coupled vibrational cues similar to elephants. Snakes receive signals by sensors in the lower jaw or body, invertebrates by sensors in the legs or body earthworms , birds by sensors in the legs pigeons or bill-tip shorebirds , kiwis and ibises , mammals by sensors in the feet or lower jaw mole rats and kangaroos by sensors in the legs. Arachnids use slit sense organ. In vertebrate animals the sensors are Pacinian corpuscles in placental mammals, similar lamellated corpuscles in marsupials, Herbst corpuscles in birds and a variety of encapsulated or naked nerve endings in other animals. Alternatively, the sensory receivers may be centralized in the cochlea of the inner ear. Vibrations are transmitted from the substrate to the cochlea through the body bones, fluids, cartilage, etc. Vibrations then project to the brain along with cues from airborne sound received by the eardrum. This is the range in which elephants may communicate seismically. Both airborne and vibrational waves are subject to interference and alteration from environmental factors. Factors such as wind and temperature influence airborne sound propagation, whereas propagation of seismic signals are affected by the substrate type and heterogeneity. Benefits and costs of vibrational communication to the signaler are dependent on the function of the signal. For social signaling, daylight and line-of-sight are not required for seismic communication as they are for visual signaling. Likewise, flightless individuals may spend less time locating a potential mate by following the most direct route defined by substrate-borne vibrations, rather than by following sound or chemicals deposited on the path. Here, communication typically ranges from 0. It has been suggested that vibrational signals might be adapted to transmit through particular plants. White-lipped frog[edit] European tree frog with distended gular pouch One of the earliest reports of vertebrate signaling using vibrational communication is the bimodal system of sexual advertisement of the white-lipped frog Leptodactylus albilabris. Males on the ground sing airborne advertisement songs that target receptive females, but instead of supporting themselves on their front limbs as other frogs often do, they partially bury themselves in soft soil. Advertising males space themselves at distances of 1â€”2 m, thus, the nearest neighbour males are able to receive and respond to substrate-borne vibrations created by other males. The Namib Desert golden mole Eremitalpa granti namibensis is a blind mammal whose eyelids fuse early in development. The ear lacks a pinna , the reduced ear opening is hidden under fur and the organization of the middle ear indicates it would be sensitive to vibrational cues. The exact mechanism of extracting directional information from the vibrations has not been confirmed. This research is helping our understanding of behaviours such as how elephants can find distant potential mates and how social groups are able to coordinate their movements over extensive ranges. In this way, elephants are able to use seismic vibrations at infrasound frequencies for communication. To listen attentively, individuals will lift one foreleg from the ground, possibly triangulating the source, and face the source of the sound. Occasionally, attentive elephants can be seen to lean forward, putting more weight on their front feet. These behaviours presumably increase the ground contact and sensitivity of the legs. Sometimes, the trunk will be laid on the ground. Elephants possess several adaptations suited for vibratory communication. The cushion pads of the feet contain cartilaginous nodes and have similarities to the acoustic fat melon found in marine mammals like toothed whales and sirenians. In addition, the annular muscle surrounding the ear canal can constrict the passageway, thereby dampening acoustic signals and allowing the animal to hear more seismic signals. An elephant running or mock charging can create seismic signals that can be heard at great distances. When detecting the vibrational cues of an alarm call signaling danger from predators, elephants enter a defensive posture and family groups will congregate. After the Boxing Day tsunami in Asia, there were reports that trained elephants in Thailand had become agitated and fled to higher ground before the devastating wave struck, thus saving their own lives and those of the tourists riding on their backs.

Chapter 3 : Insect - Wikipedia

Ho How do insects communicate? MSU N 6 o. Try this pretend insect language or make up your own! Learn about opportunities to participate in upcoming science activities and events at.

The segments of the body are organized into three distinctive but interconnected units, or tagmata: The thorax is made up of three segments: Each thoracic segment supports one pair of legs. The meso- and metathoracic segments may each have a pair of wings , depending on the insect. The abdomen consists of eleven segments, though in a few species of insects, these segments may be fused together or reduced in size. The abdomen also contains most of the digestive , respiratory , excretory and reproductive internal structures. Segmentation[edit] The head is enclosed in a hard, heavily sclerotized, unsegmented, exoskeletal head capsule, or epicranium , which contains most of the sensing organs, including the antennae, ocellus or eyes, and the mouthparts. Of all the insect orders, Orthoptera displays the most features found in other insects, including the sutures and sclerites. In prognathous insects, the vertex is not found between the compound eyes, but rather, where the ocelli are normally. In some species, this region is modified and assumes a different name. The anterior segment, closest to the head, is the prothorax, with the major features being the first pair of legs and the pronotum. The middle segment is the mesothorax, with the major features being the second pair of legs and the anterior wings. The third and most posterior segment, abutting the abdomen, is the metathorax, which features the third pair of legs and the posterior wings. Each segment is dilineated by an intersegmental suture. Each segment has four basic regions. The dorsal surface is called the tergum or notum to distinguish it from the abdominal terga. In turn, the notum of the prothorax is called the pronotum, the notum for the mesothorax is called the mesonotum and the notum for the metathorax is called the metanotum. Continuing with this logic, the mesopleura and metapleura, as well as the mesosternum and metasternum, are used. Each segment of the abdomen is represented by a sclerotized tergum and sternum. Terga are separated from each other and from the adjacent sterna or pleura by membranes. Spiracles are located in the pleural area. Variation of this ground plan includes the fusion of terga or terga and sterna to form continuous dorsal or ventral shields or a conical tube. Some insects bear a sclerite in the pleural area called a laterotergite. Ventral sclerites are sometimes called laterosternites. During the embryonic stage of many insects and the postembryonic stage of primitive insects, 11 abdominal segments are present. In modern insects there is a tendency toward reduction in the number of the abdominal segments, but the primitive number of 11 is maintained during embryogenesis. Variation in abdominal segment number is considerable. If the Apterygota are considered to be indicative of the ground plan for pterygotes, confusion reigns: The orthopteran family Acrididae has 11 segments, and a fossil specimen of Zoraptera has a segmented abdomen. The procuticle is chitinous and much thicker than the epicuticle and has two layers: The tough and flexible endocuticle is built from numerous layers of fibrous chitin and proteins, criss-crossing each other in a sandwich pattern, while the exocuticle is rigid and hardened. Insects are the only invertebrates to have developed active flight capability, and this has played an important role in their success. Having their muscles attached to their exoskeletons is more efficient and allows more muscle connections; crustaceans also use the same method, though all spiders use hydraulic pressure to extend their legs, a system inherited from their pre-arthropod ancestors. Unlike insects, though, most aquatic crustaceans are biomineralized with calcium carbonate extracted from the water. The head capsule is made up of six fused segments, each with either a pair of ganglia , or a cluster of nerve cells outside of the brain. This arrangement is also seen in the abdomen but only in the first eight segments. Many species of insects have reduced numbers of ganglia due to fusion or reduction. Some insects, like the house fly Musca domestica , have all the body ganglia fused into a single large thoracic ganglion. At least a few insects have nociceptors , cells that detect and transmit signals responsible for the sensation of pain. The larvae reacted to the touch of the heated probe with a stereotypical rolling behavior that was not exhibited when the larvae were touched by the unheated probe. These macromolecules must be broken down by catabolic reactions into smaller molecules like amino acids and simple sugars before being used by cells of the body for energy, growth, or reproduction. This break-down process is known as digestion. The alimentary canal directs food unidirectionally from the mouth to the anus. It has three sections, each of which performs a different process of digestion. In addition to the alimentary canal, insects also have paired salivary glands and salivary reservoirs. These structures usually reside in the thorax, adjacent to the foregut. The salivary ducts lead from the glands to the reservoirs and then forward through the head to an opening called the salivarium, located behind the hypopharynx. By moving its mouthparts element 32 in numbered diagram the insect can mix its food with saliva. The mixture of saliva and food then travels through the salivary tubes into the mouth, where it begins to break down. Insects using extra-oral digestion expel digestive enzymes onto their food to break it down. This strategy allows insects to extract a significant proportion of the available nutrients from the food source. It can be divided into the foregut , midgut and hindgut. Foregut[edit] Stylized diagram of insect digestive tract showing malpighian tubule , from an insect of the order Orthoptera The first section of the alimentary canal is the foregut element 27 in numbered diagram , or stomodaeum. The foregut is lined with a cuticular lining made of chitin and proteins as protection from tough food. The foregut includes the buccal cavity mouth , pharynx , esophagus and crop and proventriculus any part may be highly modified , which both store food and signify when to continue passing onward to the midgut. As the salivary glands produce fluid and carbohydrate-digesting enzymes mostly amylases , strong muscles in the pharynx pump fluid into the buccal cavity, lubricating the food like the salivarium does, and helping blood feeders, and xylem and phloem feeders. From there, the pharynx passes food to the esophagus, which could be just a simple tube passing it on to the crop and proventriculus, and then onward to the midgut, as in most insects. Alternately, the foregut may expand into a very enlarged crop and proventriculus, or the crop could just be a diverticulum , or fluid-filled structure, as in some Diptera species. Note the contraction of the abdomen to provide internal pressure Midgut[edit] Once food leaves the crop, it passes to the midgut element 13 in numbered diagram , also known as the mesenteron, where the majority of digestion takes place. Microscopic projections from the midgut wall, called microvilli , increase the surface area of the wall and allow more nutrients to be absorbed; they tend to be close to the origin of the midgut. In some insects, the role of the microvilli and where they are located may vary. For example, specialized microvilli producing digestive enzymes may more likely be near the end of the midgut, and absorption near the origin or beginning of the midgut. Envaginations at the anterior end of the hindgut form the Malpighian tubules, which form the main excretory system of insects. Excretory system[edit] Insects may have one to hundreds of Malpighian tubules element These tubules remove nitrogenous wastes from the hemolymph of the insect and regulate osmotic balance. Wastes and solutes are emptied directly into the alimentary canal, at the junction between the midgut and hindgut. Insect reproductive system The reproductive system of female insects consist of a pair of ovaries , accessory glands, one or more spermathecae , and ducts connecting these parts. The ovaries are made up of a number of egg tubes, called ovarioles , which vary in size and number by species. The number of eggs that the insect is able to make vary by the number of ovarioles with the rate that eggs can develop being also influenced by ovariole design. Female insects are able make eggs, receive and store sperm, manipulate sperm from different males, and lay eggs. Accessory glands or glandular parts of the oviducts produce a variety of substances for sperm maintenance, transport and fertilization, as well as for protection of eggs. They can produce glue and protective substances for coating eggs or tough coverings for a batch of eggs called oothecae. Spermathecae are tubes or sacs in which sperm can be stored between the time of mating and the time an egg is fertilized. Most male insects have a pair of testes, inside of which are sperm tubes or follicles that are enclosed within a membranous sac. The follicles connect to the vas deferens by the vas efferens, and the two tubular vasa deferentia connect to a median ejaculatory duct that leads to the outside. A portion of the vas deferens is often enlarged to form the seminal vesicle, which stores the sperm before they are discharged into the female. The seminal vesicles have glandular linings that secrete nutrients for nourishment and maintenance of the sperm. The ejaculatory duct is derived from an invagination of the epidermal cells during development and, as a result, has a cuticular lining. The terminal portion of the ejaculatory duct may be sclerotized to form the intromittent organ, the aedeagus. The remainder of the male reproductive system is derived from embryonic mesoderm, except for the germ cells, or spermatogonia , which descend from the primordial pole cells very early during embryogenesis.

Chapter 4 : Animal communication | calendrierdelascience.com

Introduction. Insects use touch, visual signals and sound to pass on information, such as possible dangers and new food sources. Many insects do not see very well, so they communicate with other senses.

General Pest Stories ants , body language , grey squirrels , Pest Communication , pheremones , rats , wasps , yellow jackets Leave a Comment We all know that humans are not the only animals that communicate with each other. Barking, chirping, howling â€" almost any noise an animal intentionally makes can be considered communication. But sometimes you need to know how pests communicate to understand how to effectively treat infestations , like breaking the code of an enemy army. So with that in mind, here are some of the amazing ways common pests communicate. Rats Rats communicate with each other via both body language and, of course, squeaks, though many rat squeaks are too high to be heard by the human ear. They emit two different kinds of squeaks â€" low frequency in the 22kHz range which are used as alarm cries; and high frequency squeaks in the 50kHz range which are used during play, mating and when eating. The body language rats use to communicate can vary â€" for example when they are tense or feel aggressive rats will often puff out their fur and hunch their backs. But they also use teeth grinding as a method of communication. Soft grinding, called bruxing, is most often used to express contentment. Conversely, rats will grind their teeth aggressively to produce sharper cracking sounds. This is called chatter and signals that the rat feels incredibly stressed. Yellow Jackets Yellow Jackets generally communicate through two main methods: Wasps use their antennae to smell, hear and touch, and perhaps unsurprisingly, their antennae are incredibly complex. Each antenna has at least 11 short joints and 1 ball-and-socket joint, making it incredibly flexible. But the really amazing part of the antenna is the flagellum, which contains microscopic hearing and smelling organs. Wasp antennae can identify other wasps and find food, and if a wasp identifies a familiar wasp, it may offer the other wasp some of the food it collected to reinforce the social hierarchy of the nest. Wasps also communicate by releasing pheremones. The queen wasp releases a pheremone that triggers infertility in the worker wasps which are also female , and when a wasp stings something, it releases a pheremone that signals it is in danger to other wasps. Wasps within around a foot radius will respond by coming to the aid of the stinging wasp. Wasps will also release this pheremone when they die, so you must never swat a wasp near its nest, or you will face the wrath of a whole load of angry stingers. Ants Like wasps, ants communicate with pheremones, but ants are much more sensitive to the pheremones, as that is the primary way they communicate except for a few species which also communicate by rubbing together their manibles and end segments. Just about everyone at one point in their lives has drawn a leaf through the path of some ants just to watch them scatter in confusion. This is because their pheremone trail, directing one another to a food source, had been disrupted. But despite how easily their trails can be scattered, their pheremones can do amazing things, even to other species of ants. They mark trails by trailing pheremones on their way back to the nest from having found a food source, but if that trail gets blocked, the ants will scatter as they did back when you were a child to find a new route to the food. If an ant finds a good route, it will lay down a new scent, which will get followed by other ants and reinforced on their way back to the nest, eventually resulting in the quickest path from the food to the nest. Beyond that, ants will also release alarm pheremones when crushed, which will cause surrounding ants to attack. Grey squirrels Squirrels , like rats, use audible signals to communicate, using a series of chirps to indicate everything from laughter to alarm. Their frequency range is normally between. The sounds are then used with tail gestures to form most squirrel communication. Squirrel sounds can include an almost mouse-y squeak, chatter and a low-pitched noise, and if you see a squirrel flick its tail, that means it wants you to go away. Despite all the vocalisations and body language, squirrels are mostly solitary creatures, so almost all of their communications are meant to warn other animals away from their food or territory. So despite how cute it sounds when a squirrel comes up and starts chattering at you, in truth, it is probably being very rude indeed. Alicia I joined Rentokil just over two years ago and am no stranger to pest control - a number of unwelcome tenants have made my home their home too. Having lived in a number period properties, I learned long ago that the ancient beams, sash windows and chimney breasts are also adored by spiders, insects and furries.

Chapter 5 : 10 ways to communicate more effectively with customers and co-workers - TechRepublic

Entomology Today January 14, Leave a Comment Most insects use chemical signals for a wide variety of functions, such as communicating species and sex. Social insects, such as ants that live in colonies, can also differentiate the different castes â€” workers, queens, and drones â€” according to the chemical cues.

Irene Lobato Vila 11 comentaris How do ants know what path to follow? Which mechanisms do some male and female moths use to meet each other when located far away? As humans along history, insects have developed different ways to communicate with each other. Do you want to know how and for what purpose do insects communicate by all its senses? Insects language Communication is defined as an exchange of information between two or more individuals: While in humans communication passes through a long learning process, in insects the same process tends to be an inborn mechanism: What does it means? That the emitter insect sends a missage to the rest of organisms by doing some action e. Why do insects communicate? Insects communicate both with organisms of the same species intraspecific communication and directly or indirectly with organisms of other species interspecific communication for many reasons: To localize sources of recourses: As a way to camouflage or to mimic other organisms Do you want to learn more about animal mimicry? Language through senses Insects use almost all senses to communicate. Although nervous system in insects is underdeveloped compared to the one of vertebrates, tactile communication is based on the same principle: Since long ago, we know that ants walk in line one after another because some of them leave a chemical track that the rest of individuals follow to not get lost. But, aside of emitting these chemical signals, some ant species seem to establish an strategic physical contact system known as tandem running: Dancing bees Honey bees Apis mellifera perform dances to show other members of their colonies where nectar is located direction and distance and also if it has a high quality. Bees dance inside their hives, so this performance takes place in deep darkness. Because the sense of sight is not necessary in this case to transmit the information: Look at these dancing bees! In this type of communication, the emitter scatters chemical substances at the environment which are detected by other organisms. There exists a lot of types of chemical substances: Even more important than how they scatter those substances, is the system they use to detect them: We can say they can savor and smell these substances with almost all parts of their body! Love gives you wingsâ€¦and pheromones! Females of some moth species emit pheromones that can be detected even by male moth located kilometers away. This is the case of Small Emperor Moth females Saturnia pavonia , which attract males located almost 16km away. Saturnia pavonia male above and female below. Your smell betrays you! Communication can take place among insects of the same or different species. Euclytia flava is a bedbug parasitoid learn more about parasitoids here that detects its hosts by the way they smell: While humans can detect sounds in a range from 20 to The summer sound Cicades are amazing for many reasons: They emit these sound by stridulatory organs located in the abdomen, and are received by an auditory organs located on their legs or thorax. Listen to this cicade singing! Dangerous insects planet Youtube channel. Can see how its abdomen vibrates? Some cicades are able to emit sounds that exceeds decibels they almost reach the human ear pain threshold! The sounds of cicades have many purposes, although they use it specially for finding a mate or to delimitate their territory. Each species has specific color patterns, which can be useful for identifying members of the same species, also to attract a mate o even to alert other organisms about its dangerousness aposematic mimicry; learn more about it here , or to drive away predators. On the other hand, there are also species that emit light signals to attract other specimens e. Caligo memnon, with its spots that resemble two big owl eyes and witch allow them to drive away predators Picture by Edwin Dalorzo, CC. Lights in the dark Fireflies are the most common example of communication mediated by bioluminescent signals, but there exist more insects which are able to emit light: The click beetle Pyrophorus Noctilucus has two small bioluminescent organs located behind its head. The light of these organs get more intense when being menaced Image source: Larvae or larviform adult females from the beetle genus Phrixothrix emit two types of light: They emit red light by two organs located in their heads only when they feel menaced in order to alert other larvae about the presence of predators image source: As you see, insects communicate in some different ways. Do you dare to discover how do insects that live near you communicate? C; Briegel H; Robert D. The Journal of Experimental Biology. Kairomone strains of Euclytia flava Townsend , a parasitoid of stink bugs. Journal of Chemical Ecology, Volume 28, Issue 8, pp Franks, Tom Richardson Teaching in tandem-running ants.

Chapter 6 : Stick Insect Antennae - Scholarpedia

Ask students if they can think of any examples of insects using sound for communication. One important example is bees guiding other bees to the hive, or nest.

Insects communicate through touch, visual signals, sound and chemicals Insects communicate by touch with their antennae and mouths Insects communicate visually through combinations of flashes of light and combinations of colour Insects make sounds to communicate with their own species and scare away predators Insects produce chemicals to send signals to other animals Introduction Insects use touch, visual signals and sound to pass on information, such as possible dangers and new food sources. Many insects do not see very well, so they communicate with other senses. They communicate by touch, sending out visual signals, sounds, and through chemical messages. Touch Insects communicate through touch with their antennae and their mouths. This form of communication is very useful when insects that are living in dark places need to recognise other insects that they live with. Ants use touch and chemical signals to clean each other with their antennae and mouths. When a scout bee finds a new field of flowers for its food, it returns to the hive and does a special figure-eight dance on the honeycomb. The other bees touch the scout bee with their antennae and the movements of the bee during the dance tell the other insects where to go to get to the food. See image 2 and animation Visual communication Some flies and beetles can make light. Fireflies are a type of beetle that make flashes of light. After dark, female fireflies sit on the ground while the males fly above them. Each species of male firefly flashes their own signal of light from their bodies. The female looks for the signal from the firefly of her own species and signals back to him. He then lands beside her so that they can begin the mating process. See image 3 Butterflies, flies and other insects use colours in visual communication. Some male flies have bright spots on their wings that they flap around and show off to females during the mating season. The ultraviolet patterns can be seen by other butterflies and are used as visual communication signals when the butterflies are looking for mates. Many insects communicate by supersonic sounds, which are so high that the human ear cannot detect them. When insects produce sound by rubbing parts of their body together it is called stridulation. The sound that grasshoppers make is caused by them rubbing their legs against their wings. Many of the sounds that insects make cannot be heard by humans without using special instruments that make the sounds much louder. See image 5 Pheromones are the chemical messages that insects use to communicate with other members of the same species. Sex pheromones are used to attract insects of the same species for mating. Aggregation pheromones are used to send out messages to many insects within one species. Alarm pheromones are signals that are put out by insects if they are disturbed or threatened. This type of signal makes ants run out of their tunnels and all over ground if their nest is disturbed. Trail pheromones are used by ants, caterpillars and other insets. These signals are like maps that help insects to find food. The first insect to find the food leaves a trail of scent back to the insect colony. The other insects can then follow this trail to find more food. Allomones is another name for the warning signals that insects send out to other species. Some allomones can be very smelly and may even cause blindness to the animal that it is directed at.

Chapter 7 : Spiele Zum Geld Verdienen Unter 18 Online Casino Eroffnen Ohne Einzahlungstartguthaben

They've evolved the use of chemicals to communicate with insects and each other in order to thrive. Here are five behaviors that show how active plants can be. 1.

Stick insects continuously move their antennae during walking. The video shows a blindfolded stick insect walking towards a block of wood. Note that the video was slowed down five-fold. Next to the walkway, there was a mirror mounted at an angle of 45 degrees, allowing synchronous recording of top and side views. If an antenna touches an obstacle, as the right antenna does in this video, then this touch event leads to an appropriate action of the front leg on the same side. Stick insects use their antennae for obstacle detection during locomotion. When blindfolded, stick insects walk towards a block of wood top left they can readily climb obstacles that are much higher than the maximum foot height during a regular step. Following antennal contact with the obstacle, the next step is raised higher than normal bottom left and top right: Antennal contact during early swing often leads to re-targeting top right. Contact during late swing typically ensues a correcting step right middle. Antennal contact during stance leads to a higher step than regular lower right. Red lines and dots show trajectories and contact sites of the antennal tip first contact only. Black lines and dots show the body axis and head every 40 ms. Following antennal contact, body axis lines are drawn in grey. Like many other insects, C. By doing so, it actively raises the likelihood of tactile contacts with obstacles because each up-down or rear-to-front sweep of an antenna samples a volume of space immediately ahead. Accordingly, the antennal movement pattern can be considered an active searching behaviour. During this searching behaviour, antennal movement is generated by rhythmic movement of both antennal joints with the same frequency and a stable phase shift Krause et al. Moreover, it is clear that this searching movement is generated within the brain, despite the fact that the brain requires additional activation, possibly through ascending neural input from the suboesophageal ganglion Krause et al. Antennal searching movements have been shown to be adapted according to the behavioural context, e. This can be seen in Movie 1, showing a blindfolded stick insect that walks towards a block of wood. During approach of the obstacle, the top view shows how both antennae are moved rhythmically from side to side. Soon after a brief contact of the right antenna, the insect lifts its ipsilateral leg higher than normal and steps onto the top of the block same trial as in Fig. Examples like this show that stick insects respond to antennal tactile contact with appropriate adaptation of their stepping pattern and leg movements. Depending on the timing of the antennal contact with respect to the step cycle of the ipsilateral leg, three kinds of behavioural responses are easily distinguished: The first kind is the one shown in the video Movie 1. If the antennal contact occurs during early swing, the foot trajectory often reveals a distinct upward kink, indicating re-targeting of an ongoing swing movement Fig. Essentially this means that antennal touch information can interfere with the cyclic execution of the normal stepping pattern of the front legs, such that it can trigger re-targeting of an ongoing swing movement. The second kind occurs when the antennal contact happens during late swing. In this case, reaction time appears to be too short for re-targeting and the foot hits the obstacle, only to be raised in a second, correcting step Fig. Finally, in the third kind of response, antennal contact occurs during stance. Then, stance movement is completed and the following swing movement is higher than a regular step Fig. The analysis of adaptive motor behaviour in response to antennal touch can be simplified if the touched obstacle is nearly one-dimensional, e. In this case, it can be demonstrated that antennal touch information is not only used for rapid adaptation of goal-directed leg movements, but also triggers distinct changes of the antennal tactile sampling pattern, including an increase in cycle frequency and a switch in inter-joint coupling. Therefore, tactile sampling behaviour is clearly distinct from searching behaviour. Tactile sampling of other obstacles, e. In both Carausius and Aretaon, antennal contact information ensues a change in leg movement, as necessary during climbing. Similar tactually mediated climbing behaviour has been described in the cockroach. In summary, tactile information from the antenna induces an adjustment of leg movements in a context-dependent manner. Moreover it induces changes in the antennal movement itself. Antennae are dedicated sensory limbs Figure 3: Stick insects can regenerate a leg in place of an antenna. The top image shows the head and first half of the antennae of an adult female stick insect. Each antenna has three functional segments: The larvae of stick insects look very similar to the adult, except that they are smaller. If an antenna of a larva is cut at the level of the proximal pedicel dashed line , the animal often regenerates a leg instead of an antenna during the next moult. The bottom image shows the head and antennapedia regenerates of a stick insect whose antennae were cut in the third or fourth instar same scale as above. The antenna of the Arthropoda crustacea, millipedes and insects carry antennae, arachnids do not is considered to be a true limb that evolved from a standard locomotory limb into a dedicated sensory limb. Various lines of evidence suggest that the segmented body structure of the arthropods once carried leg-like motor appendages on each segment. As some body segments adopted specialised functions during the course of evolution, their motor appendages changed their function accordingly. For example, the insect head is thought to have evolved by fusion of the six most frontal body segments, with three pairs of limbs having turned into mouthparts that specialised for feeding, two pairs having been lost, and one pair having turned into dedicated, multimodal sensory organs â€" the antennae. This common theory is supported by palaeontological, morphological, genetic and developmental evidence. For example, a simple experiment on stick insects illustrates the close relationship between walking legs and antennae: This "faulty" regeneration is called an antennapedia regenerate literally: Antennapedia regenerates can be induced experimentally by cutting an antenna of a stick insect larva e. The site of the cut determines the outcome of the regeneration: Note that there is also a Drosophila gene called Antennapedia. Morphological similarity between walking legs and antennae concerns the structure of joints, musculature, innervation and most types of mechanoreceptors and contact chemoreceptors Staudacher et al. Differences concern the number of functional segments five in legs, three in antennae , cuticle properties see below and sensory infrastructure e. The antenna has three functional segments: This is the same in all higher insects the Ectognatha; see Imms, In other words, true joints that are capable of active, muscle-driven movement occur only between head and scape HS-joint and between scape and pedicel SP-joint. The HS-joint is moved by three muscles inside the head capsule so-called extrinsic muscles, because they are outside the antenna , the SP-joint is moved by two muscles inside the scape so-called intrinsic muscles, because they are located inside the antenna. Four adaptations improve tactile efficiency Figure 4: The relative length of the body, antennae and front legs remain almost the same in all seven developmental stages larval stages L1 to L6, and imago. A front leg is slightly longer than an antenna. However, since the attachment site of the front leg is more posterior than that of the antenna, the tip of the antenna reaches slightly further than the front leg tarsi feet. The distance coxa-to-scape between the attachment sites is about equal to the tarsus length. All four measures increase linearly with body length see dashed lines and slopes for antenna length and coxa-to-scape. Values are from at least 6 female animals per developmental stage. Vertical dotted lines separate developmental stages. Several morphological, biomechanical and physiological properties of the stick insect antenna are beneficial for its function in tactually guided behaviour. Four of such adaptations are: Since stick insects generally are nocturnal animals, their antennae are likely to be their main "look-ahead sense" rather than the eyes. Moreover, as many stick insect species are obligatory walkers, tactile exploration is likely to serve obstacle detection and orientation during terrestrial locomotion. Thus, potentially, anything the antenna touches is located within reach of the front leg. Owing to this match, the stick insect is able to adapt its locomotory behaviour to a touch event within the action distance of one length of a leg, and with a look-ahead time of up to one step cycle period. Some of these descending interneurons have been characterized individually to quite some detail. For example, a set of three motion-sensitive descending interneurons encodes information about antennal movement velocity in a complementary manner: Because these movement-induced changes in spike rate occur with very short latency approx. Note that the length of the antennae does not match the length of the front legs in all stick insect species. In some species, like Medauroidea extradentata Redtenbacher , the antennae are much shorter than the front legs, indicating that their antennae are not suited for tactile near-range searching because the feet of the front leg will nearly always lead the antennal tips. In the case of M. Thus, in these animals the front legs appear to take on the function of tactile near-range searching. Coordinated movement of antennae and legs Figure 5: During walking, antennal movements are often coordinated with the stepping movements of the legs. Light gray arrows indicate a back-to-front wave that describes the coordination pattern of left limbs top and right limbs bottom. Spatial trajectories of antennal tips red and front leg tarsi blue during a walking sequence of four steps. Side view top and top view bottom of left broken lines and right solid lines limbs. Bold gray lines connect coincident points. Note how these lines always curve in the same direction. Temporal coordination is revealed by the gait pattern of a straight walking stick insect in Fig. The pattern is the same for left and right limbs. In both cases, coordination is well-described by a rear-to-front wave travelling along the body axis indicated by grey arrows. As if activated by such a wave, the middle legs follow the hind leg rhythm, the front legs follow the middle legs, and the antennae follow the front legs. Note that this pattern depends on walking conditions and behavioural context. Antennae and front legs are also coordinated spatially Fig. Both, temporal and spatial coordination support the hypothesis that the antenna actively explores the near-range space for objects which require the ipsilateral leg to adapt its movement. Indeed, it has been shown that the likelihood of the antenna to detect an obstacle before the leg gets there, i.

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Chapter 8 : How do insects communicate? | All you need is Biology

7 I use email to communicate complex issues with people. It's quick and efficient. It's quick and efficient. 8 When I finish writing a report, memo, or email, I scan it quickly for typos and so forth, and then send it off right away.

Any number of team members. Instructions Explain to participants that they will have to form a team based on the instructions that you shout out. For example, some instructions could include "Get into a team with people who have the same number of children as you" or "Get into a team with people who like similar types of music to you. People can shout out or sit down to signal that their team is "complete. Repeat the exercise as many times as you want. Advice for the Facilitator Talk with your team about how this activity encouraged them to communicate. How could they learn to open up and communicate more effectively in work situations in the future? The Elephant List This exercise is for teams that are committed to open and honest conversations, even when the subject is a difficult one. Not all exercises are light-hearted or playful. This exercise requires a very experienced facilitator. Your team members may be reluctant to discuss contentious issues in a group, or they may be fearful of raising subjects that could be seen as "off limits" to them. The facilitator will need to reassure participants that they can do so in a safe, trusting environment. Any number of team members but, if there are more than six or seven people taking part, you may have to have a quick vote to decide which "elephants" to address, and in which order. Sticky notes or small sheets of paper with an elephant image, which you can call "elephant sheets" you can get creative here! Three flip charts in a wide circle, or in a U-shape. You can set your own time limit for discussions. Assemble your team and explain the objectives of the exercise, which are: This means deciding whether they are issues that the participants have Control over, that they can Influence, or that they need to Accept. Hand out the sticky notes or elephant sheets, and give your team members five minutes to write down one elephant. They should also write whether their elephant is C, I or A. Putting their names on the sheet or sticky note is optional. Collect the elephants, read them aloud one by one, then record them on the relevant flip charts marked C, I or A. As mentioned above, if you have a large number of elephants or are limited by time, you may need to vote on which ones to address. Decide as a group whether the A elephants really are issues that just have to be accepted, and agree on whether any of the C or I elephants are actually A elephants. Then, let the A-list elephants go. Basically, just accept them. Tackle C and I elephants in open conversations, and try to come up with solutions or action items. Look at each elephant through the "4 Ws. What are we doing about it? Who can resolve this issue? When can we resolve this? Advice for the Facilitator Define specific actions that your whole team agrees with and create an action plan to carry them out. Then, continue to coach and support your team when addressing other elephants in the future. The Elephant List is reproduced with permission from Gabriele Bankers, an organization development specialist from Denver, U. People get into pairs and one member talks about his or her opinions. His partner listens without speaking, and then, without rebuttal, recaps on what has been said. This activity also shows them how to listen with an open mind. People and Materials An even number of team members, ideally. Eight index cards for each team of two. Each card should list one topic. The topics should be interesting, but not too controversial.

Chapter 9 : Team Building Exercises: Communication - From calendrierdelascience.com

Here are 10 practical tips to guide you toward better communication in the workplace and steer you away from potential conflicts and confusion.

Communication plays a critical role in aggregation, reproductive behaviour, territoriality, dominance interactions, parental care, and cooperative interactions within families. By definition, communication involves at least one sender producing a signal conveying information that in some way alters the response of the receiver. Signaling Senders and receivers An animal that provides a signal is called a sender. The animal to which the signal is directed is the receiver. The receiver uses the signal information to help make a decision. For example, if a receiver must choose either to fight with or to flee from an opponent, it brings to this decision biases and thresholds passed on to it by successful prior generations. This information helps the receiver avoid harm and find food, shelter, and mates. If it has routinely lost fights to larger animals, a useful strategy would be to assess the size of the opponent. This may be done by using vision or other means. For example, in some cases an opponent broadcasts a low-frequency sound signal at the receiver. Because only large animals can produce low-frequency sounds, this signal provides evidence that the opponent is large. The receiver integrates its perception of the sound frequency with its prior experience and inherited avoidance of harmful situations and thus decides to flee. Impala Aepyceros melampus communicate by using a variety of signals that convey specific types of information. For example, grooming provides tactile information about physical condition, and freeze reflexes provide visual information about potential danger. In this example, the receiver can interpret the signal only if it understands that low-frequency sounds tend to be associated with large body sizes. The association between alternative signals e. Codes can be characterized as probabilities that a sender will emit a given signal in any given circumstance. In a perfect code, only one signal will be used in a given context , and only one context will evoke that signal. Real codes do not need to be perfect, but they do need to be good enough that a receiver attending to signals makes better decisions than if it ignored the signals and relied only on other sources of information. Animals differ widely in the mechanisms by which they acquire signal codes. Some codes are inherited genetically. For example, the sound-producing structures of many male insects generate a limited range of sound frequencies, and the ears of females are pretuned to be most sensitive to those frequencies. Many songbirds have genetic limits on the range of sounds they can sing, but they can learn one or more local variants within those limits during a short period in their youth. In certain species, such as parrots or humans, both sender and receiver must learn the appropriate vocal coding, and they can continue to learn alternative coding systems throughout life. Fish and Wildlife Service Different contexts require different kinds of information and thus different signals. Most animals produce signals to attract mates and then produce additional signals to synchronize mating. Signals for mediating conflicts, including signals of aggressive intention and signals of submission, are also widespread. In addition, territorial species require signals for declaring territory ownership, and in situations in which adults guard or feed their young, both parents and offspring require signals to coordinate parental care. Social animals may use signals to coordinate group movements, to assemble dispersed group members, or to display social affiliations. Some animals have special signals that they use to share food finds, to alert others about predator attacks, and even to alert approaching predators that they have been detected. In addition, bats , oilbirds , porpoises , and electric fish use the differences between their own emitted and subsequently received signals to extract information about the ambient environment. In many of these contexts, the relevant animal signals are designed to provide a receiver with ancillary information about the identity, sex, social affiliation, and location of the sender. Wolves are social animals, and they thus require a large repertoire of signals to communicate different kinds of information. Fish and Wildlife Service The challenge faced by a sender is the creation of a controlled perturbation of the environment that can be detected and recognized by a receiver. Sound production is one mechanism. Sound travels in waves, and thus any sound can be characterized by its component frequencies and the physical size of each wave component called the wavelength. The wavelength of a sound depends upon its frequency and the speed of sound in the propagating medium. The speed of sound is greatest in solids

, intermediate in water , and least in air. Thus, a given frequency of sound in water has a wavelength 4. This is important to animals using sound communication because it is physically difficult for an animal to produce a loud sound with a wavelength much larger than itself. For this reason, small animals tend to communicate with high-frequency sounds, and only large animals use low-frequency sound signals. Aquatic animals require higher-frequency signals than do similarly sized terrestrial animals. Blue arrow-poison frogs Dendrobates azureus can communicate through sound production. Their bright colour also serves as a warning signal to predators. Animal muscles cannot twitch this quickly, which makes sound production challenging. One solution is to use frequency multiplication. For example, hard-bodied animals drag a comblike structure over a sharp edge. A single muscle contraction causes the sharp edge to hit successive teeth in the comb, thereby producing a sequence of sound waves. This is called stridulation. Arthropods all have hard exoskeletons , and by mounting the comb on one external body part and the sharp edge on the other, they can stridulate by rubbing the two hard parts together. For example, lobsters rub an antenna against the head, beetles rub a leg against the body, and crickets and katydids rub one wing over another. There are other techniques for frequency multiplication. Terrestrial vertebrates use muscles to force air into and out of their lungs while breathing. If thin membranes are inserted into this airflow, the membranes will flutter, producing sound waves at much higher frequencies than the airflow cycle. This is how frogs croak, lions roar, and birds sing. Katydids use several different forms of communication. These sound waves convey specific types of information and are detected by members of the same species. Ross To be able to use different sound signals in different contexts, animals must have some way to control and vary the sounds that they produce. Varying the rhythm of insect stridulation or bird breathing is one way to produce different signals. Air-breathing vertebrates can also change the tension on the vibrating membranes to produce quite complicated frequency modulations. A third mechanism is to produce sounds that initially contain many different frequencies and then selectively filter out some frequencies and amplify others. Animals such as katydids, frogs, bats, and howler monkeys have special resonating structures attached to their sound-producing organs that select the radiated frequencies and couple the sounds to the medium. Bats have special resonating structures attached to their sound-producing organs that select specific sound frequencies. This enables them to use different sound signals in different contexts. Most visual signals rely on the presence of ambient light that is generated by the Sun. Similar to sound, light propagates as waves. When white lightâ€”which contains many different light frequenciesâ€”strikes an object, some of it is reflected, and it is this reflected light that creates a visual image of the object. If the object absorbs some frequencies of white light and reflects others, the receiver will see the object as coloured. When red light frequencies are absorbed, the object appears green or blue. When the green light frequencies are absorbed, the colour appears purple. Different animal groups tend to have different ranges of light frequencies that they can see. Birds, lizards , and some insects can see light frequencies well into the short-waved ultraviolet. Humans cannot see these short waves. Thus, in humans, objects that appear to be similar or uncoloured may be seen as different or highly coloured by a bird or a honeybee. The challenge for a sender is to produce a visible image that is detectable against the background by a receiver. One way to do this is to move the signal body part in front of a static background or to move it in a different direction relative to a moving background. This simply requires normal muscle movementsâ€”no additional structure is needed. However, many senders enlarge or decorate the moved body part to increase the chances that the receiver will notice the signal. The sender may also select a site in which to produce the signal that has a simpler background or that is moving in a very different way. Black-and-white patterns are a common solution. The black is generated by using one of several synthesizable proteins called melanins. White is created by inserting small crystals or bubbles into the organ surface. They are large enough that they scatter all light wavelengths, creating white stimuli. Colours other than black and white are more difficult to produce. Although animals cannot synthesize carotenoid pigments, they can sequester the pigments by eating certain plant parts or by eating other animals that ingest those plants. Carotenoids are relatively stable compounds , generating colours in the yellow-to-red range. There are few natural pigments that are blue or green that animals can utilize for coloration. One exception is the chemical combination of carotenoids and proteins used by arthropods to colour their carapaces hard outer coverings dark green or blue. Crabs and lobsters turn red when cooked because the pigment proteins are denatured with heat, releasing the carotenoids. Other animal groups use nonpigment techniques to produce blue or green coloration. One method uses a checkerboard matrix of alternating more-dense and less-dense materials in an external surface layer to selectively scatter certain wavelengths. The colour reflected depends on the size and spacing of the matrix. This mechanism is responsible for producing the blue and green feathers of jays and parrots , the blue skin on the heads of turkeys and male mandrills , and blue eyes in humans and snow leopards. Another technique is to use two thin layers of reflecting material on external surfaces. If the layers have the correct thickness, certain wavelengths are reflected by the two layers out of phase the crest of one wave coincides with the valley of a second wave , thereby canceling each other out. The remaining light waves are in phase the crests of the light waves coincide and are visible as intense colours. Which light waves are canceled depends on the viewing angle of the receiver. Thus, the apparent colour can change as the sender shifts its position relative to the receiver. These are the iridescent colours seen in many hummingbirds and butterflies.